Science SOL 5.4 Matter

What is matter?

- Matter is ANYTHING that takes up **space** and has **mass.**
- Matter has tiny particles called **atoms** and **molecules.** They are too small to be seen with the human eye.

3 States of Matter:

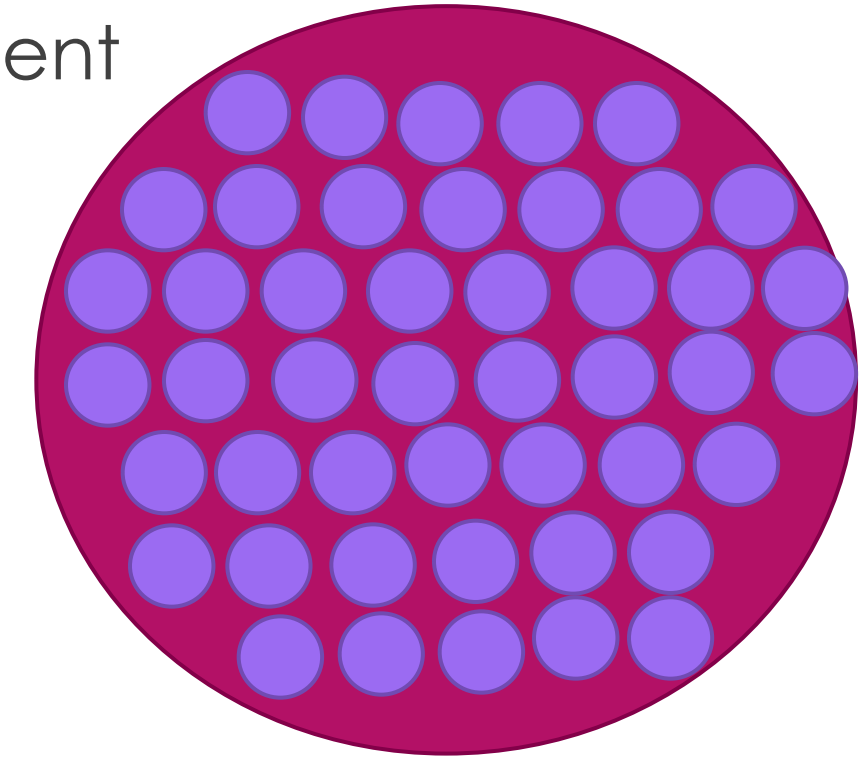
- **Solids**
- **Liquids**
- **Gases**

Solids

- Have a definite **shape** and a fixed **volume**
- Tightly packed molecules that are arranged in a regular **pattern**
- Molecules **vibrate** in a fixed position
- Example: **rocks, ice**

What the molecules of a solid look like:

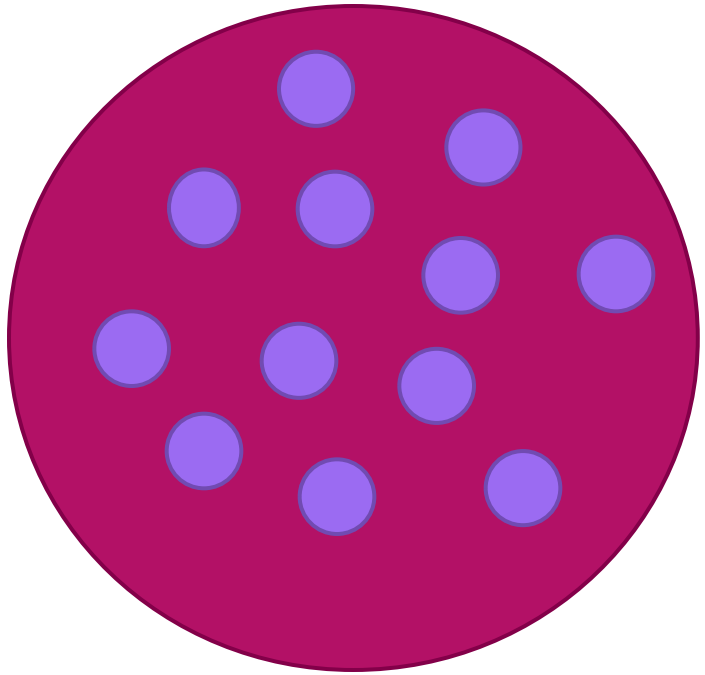
- Draw the molecules inside the circle to represent a solid.



Liquids

- Have no definite **shape**
- Molecules are **farther** apart than a solid and are not in any particular pattern or order
- Molecules move and **slide** over each other
- Examples: **lemonade, water**

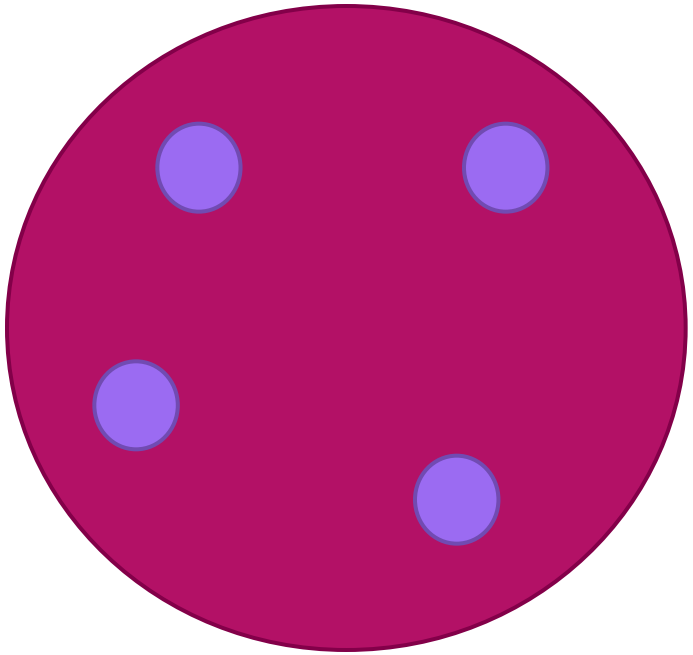
What the molecules of a liquid look like:



Gases

- Have no definite **shape**
- It will take the shape of the container and will spread out to **fill** it
- Molecules are very far **apart**
- Molecules that move about **quickly** and **freely**
- Examples: **air, water vapor**

What the molecules of a gas look like:



Changing States of Matter

- For matter to change from one **state** to another (ex. Liquid to solid, gas to liquid) **a change in temperature** must happen
- When temperature **increases**, a liquid can change to a gas, a solid can change to a liquid (ex. Liquid water changing to water vapor)
- When temperature **decreases**, a liquid can change to a solid, a gas can change to a liquid (ex. Liquid water changing to ice)

Changing States of Matter

- Freezing and boiling points of water:
- Water freezes at **0** degrees Celsius
- Water freezes at **32** degrees Fahrenheit
- Water boils at **100** degrees Celsius
- Water boils at **212** degrees Fahrenheit

Properties of Matter

- There are 2 properties of matter:
- **Physical** properties
- **Chemical** properties

Physical Properties

- Physical properties are things like:
- **Smell**
- **Color**
- **Taste**
- **State**

Chemical Properties

- Chemical properties are how one type of **matter** reacts with another type of matter

Changing Matter

- Matter can change in 2 ways:
- **Physical** Change
- **Chemical** Change

Physical Change

- A physical change changes what an object looks like but does not change what it is **made** of.
- Example: Cutting a piece of paper will make it smaller but it is still paper.

Chemical Change

- A chemical change is a change that forms a new **substance** with new **properties**
- Example: Burning a piece of wood creates smoke and ash. It is no longer a piece of wood after it is burned.

Measuring Matter

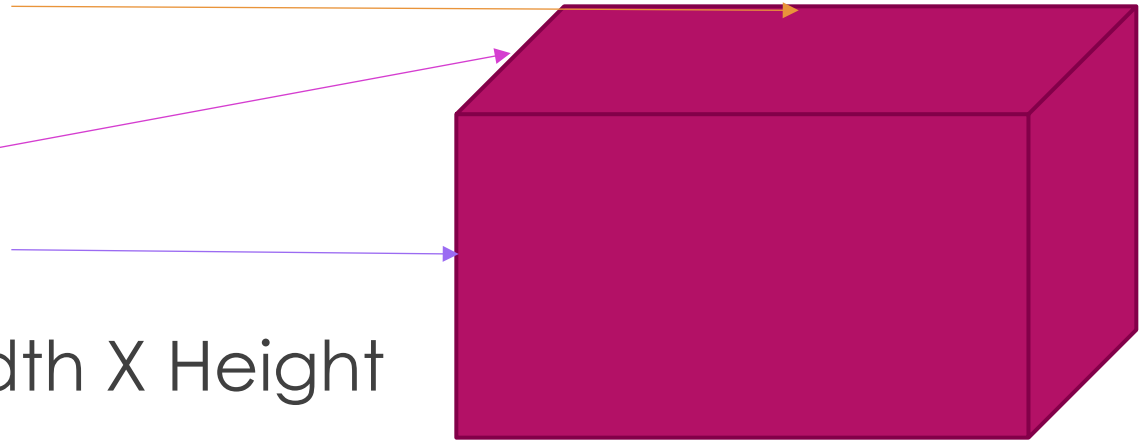
- There are 2 ways to measure matter:
- **Volume**
- **Mass**

Measuring Volume

- Volume is the amount of **space** that something takes up.
- To find the volume of a solid rectangular object, you must multiply the length x width x height.
- To find the volume of a liquid, you must use a graduated cylinder, measuring cup, etc.
- To find the volume of an **irregular** object, you can place water in a graduated cylinder, measure the water level, add the object, re-measure the water level, then subtract the 2 amounts.
- Common units used to measure volume: **in^3** (inches cubed or cubic inches, mL (milliliters)

Measuring Volume of a Solid, Rectangular Object

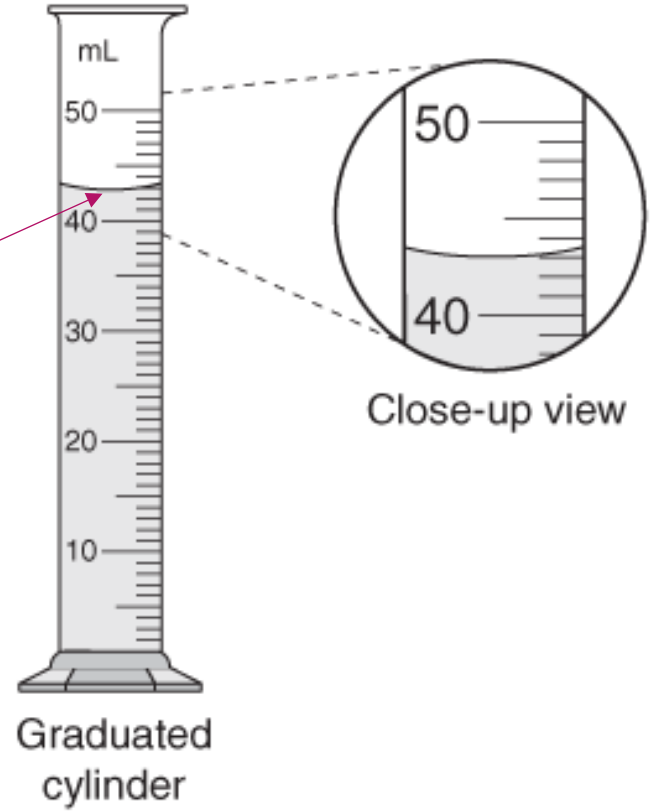
- Find the Volume of the solid rectangular object:
- Length: 4 in.
- Width: 2 in.
- Height: 3 in.



- Length x Width X Height
- **4 in. x 2 in. x 3 in. = 24 in.^{3}** (pronounced 24 inches cubed)
- You must ALWAYS show your **units**!!!!

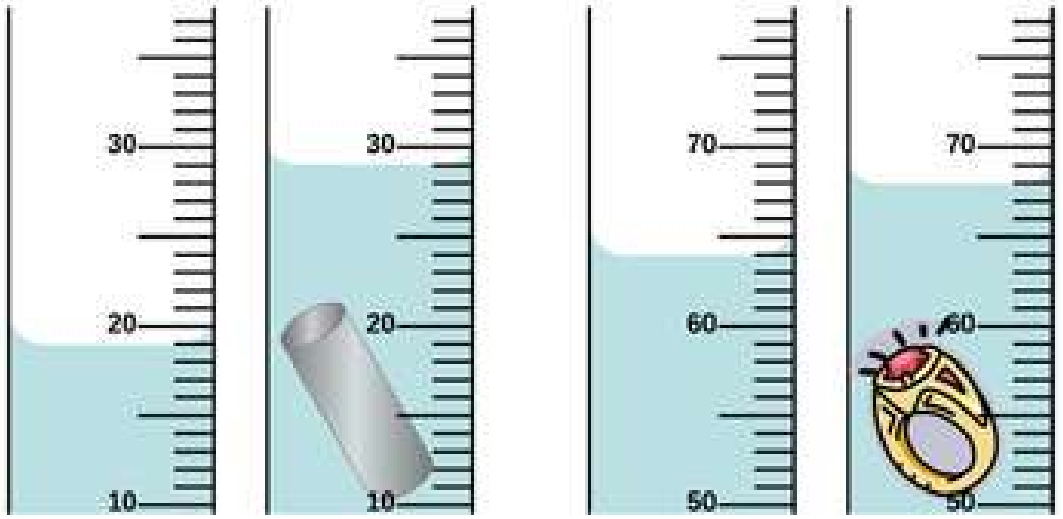
Measuring Volume of a Liquid

- Find the Volume of the liquid inside the graduated cylinder:
- You must read from the bottom of the water line, called the meniscus.
- Also, you must count the lines between the numbers to see what the value of each line is.
- Answer: **43** mL (don't forget units!)



Measuring Volume of an Irregular Object

- Find the volume of the irregularly shaped object:
- You must first measure the water level, then add the irregular object, re-measure the water level, then subtract.
- Object 1: **29 mL – 19 mL = 10 mL**
- Object 2: **68 mL – 64 mL = 4 mL**

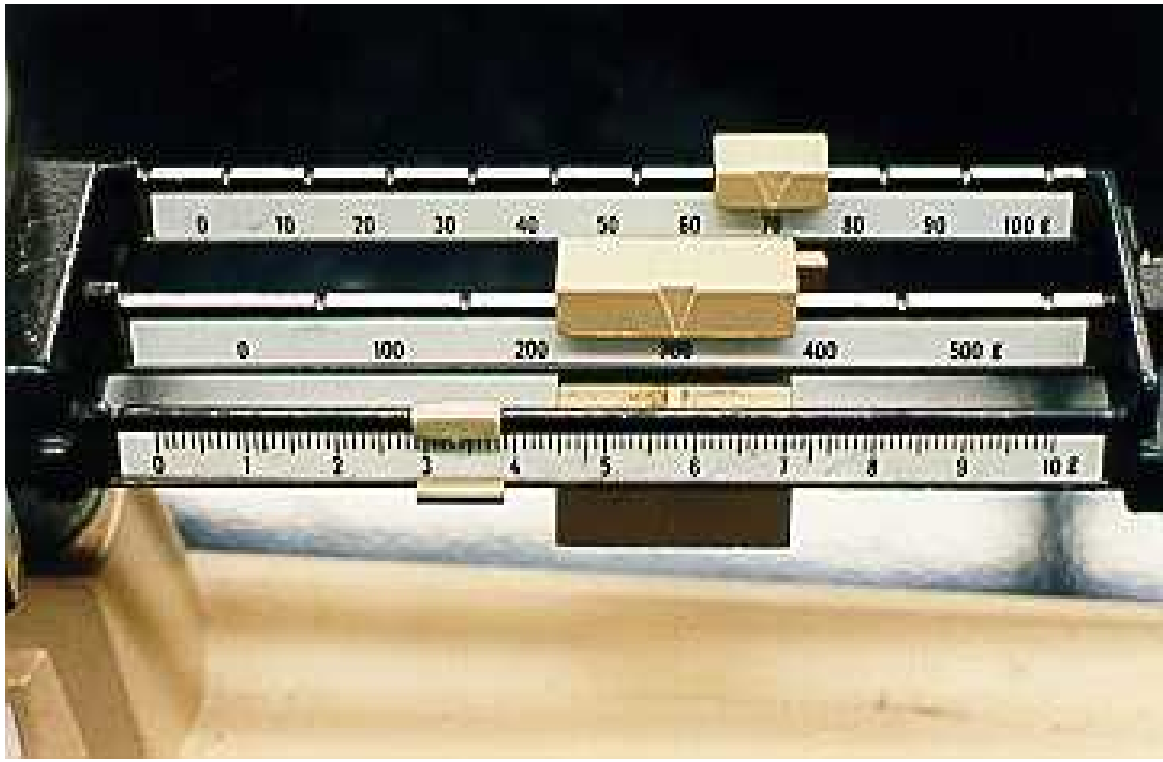


Measuring Mass

- Mass is the amount of **matter** in an object.
- **Mass is not weight**. Weight is the measure of the pull of gravity on an object. **Weight can change, mass can not**.
- Example: You will weigh 1/6 less on the moon than you do on Earth. You body's mass did not change, the weight did due to the gravitation pull.
- Calculate your weight on the moon:
- _____ pounds divided by 6 = _____ pounds

Measuring Mass

- To measure mass, you must use a balance scale and add the weights on the beams of the scale.
- Common units used to measure mass: grams, kilograms, ounces, or pounds
- Measure the mass of the scale:
- Mass = 300 g + 70 g + 3.3 g =
- **373.3 g**



Density

- Density is the amount of **mass** a substance has.
- A rock will sink to the bottom of a pool because it's density is greater than **water.**
- A boat can float on water because it's density is **less** than water.
- Items can have the same **volume**, but have different densities.
- For example, a pillow case filled with feathers is less dense that the same size pillow case filled with rocks. The volume is the same, the density is different.

Density

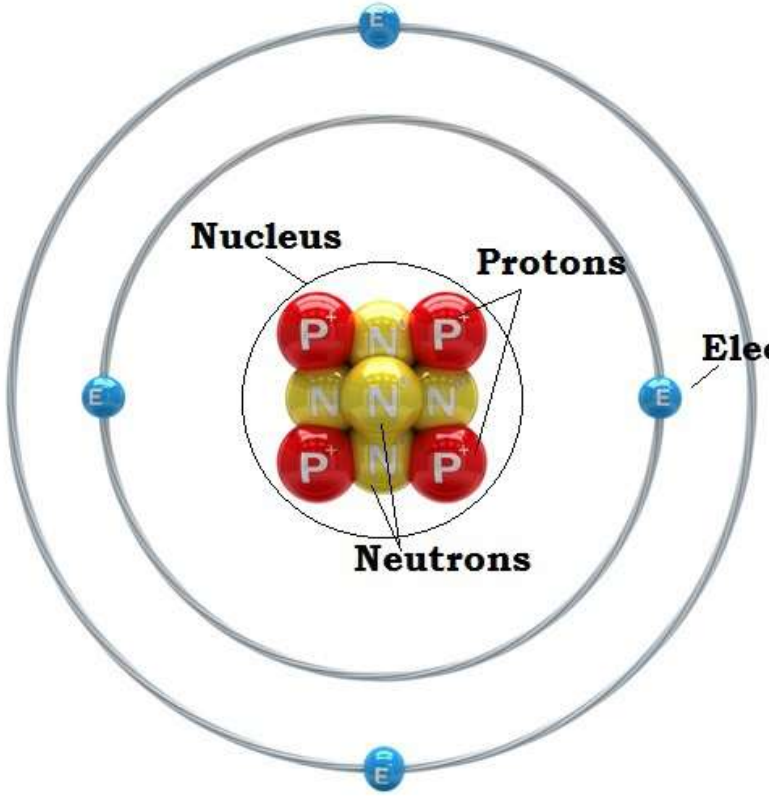
- If you look at the picture, you will see a regular can of Pepsi has more density than the same size can of Diet Pepsi.
- The regular Pepsi has greater density than water.
- The Diet Pepsi has less density than water.

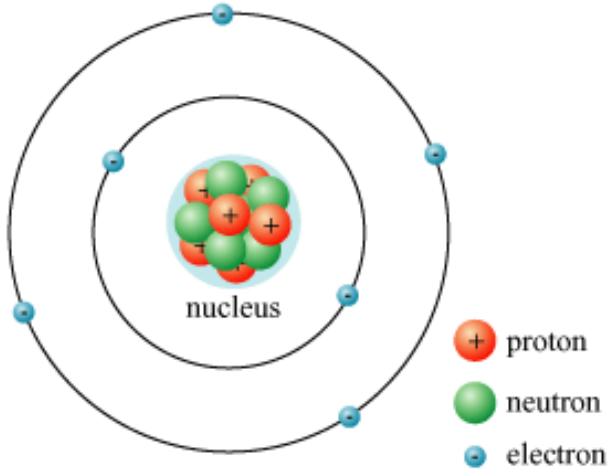
Types of Particles in Matter

- There are 4 types of particles in matter:
- **Atoms**
- **Elements**
- **Molecules**
- **Compounds**

Atoms

- All **matter** is made up of atoms.
- Atoms can only be seen with a strong **microscope.**
- All atoms have the same basic parts: **protons, neutrons, & electrons.**
- Protons & neutrons form the nucleus.
- Electrons orbit (move around) on the outside of the nucleus in the electron cloud.
- Protons have a **positive** charge, electrons have a **negative** charge, neutrons have **no charge**.
- The majority of the atom's mass is in the **nucleus**.



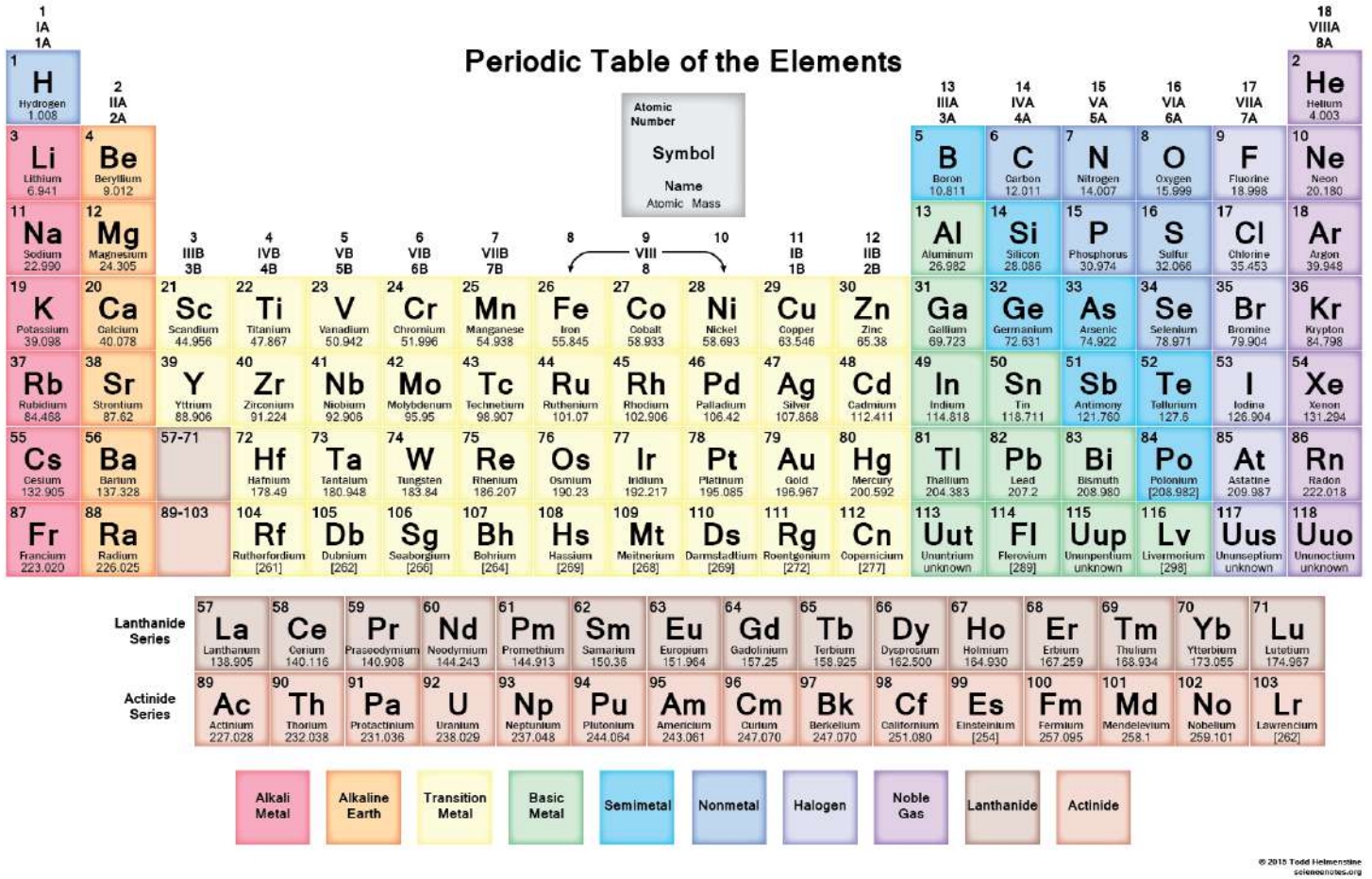


Elements

- One atom of an element is the smallest unit of an element that retains (keeps) the properties of that element.
- Atoms combine to form **elements.**
- Each element is given a name, such as, gold, hydrogen, & iron.
- The element's name and symbol identify it.
- Most elements symbols have either 1 or 2 letters, some have 3. (ex. The atomic symbol for oxygen is O and for nickel is Ni.
- The first letter of an atomic symbol is a capital letter and the 2nd and 3rd are lower case letters.
- Every element has an atomic number which is the number of protons in the nucleus. For example, Oxygen has an atomic number of 8. This means there are 8 protons in the nucleus of every Oxygen atom.

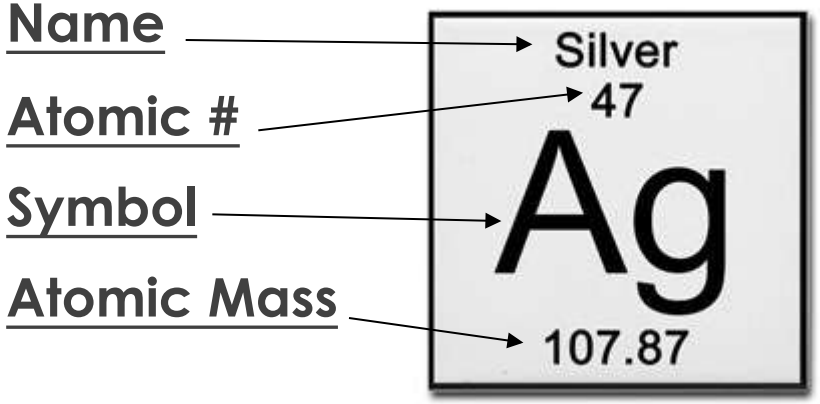
Periodic Table of Elements

- All elements are arranged on the Periodic Table of Elements in order by their atomic number (number of **protons** in their nucleus.)
- The periodic table also includes the element's name, symbol, & atomic mass.



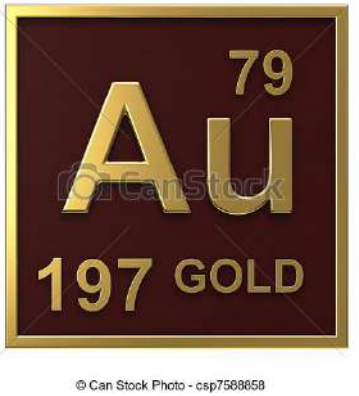
Periodic Table of Elements

- Label the Periodic Table of Elements square for Silver.



- How many protons does the element of Silver have?

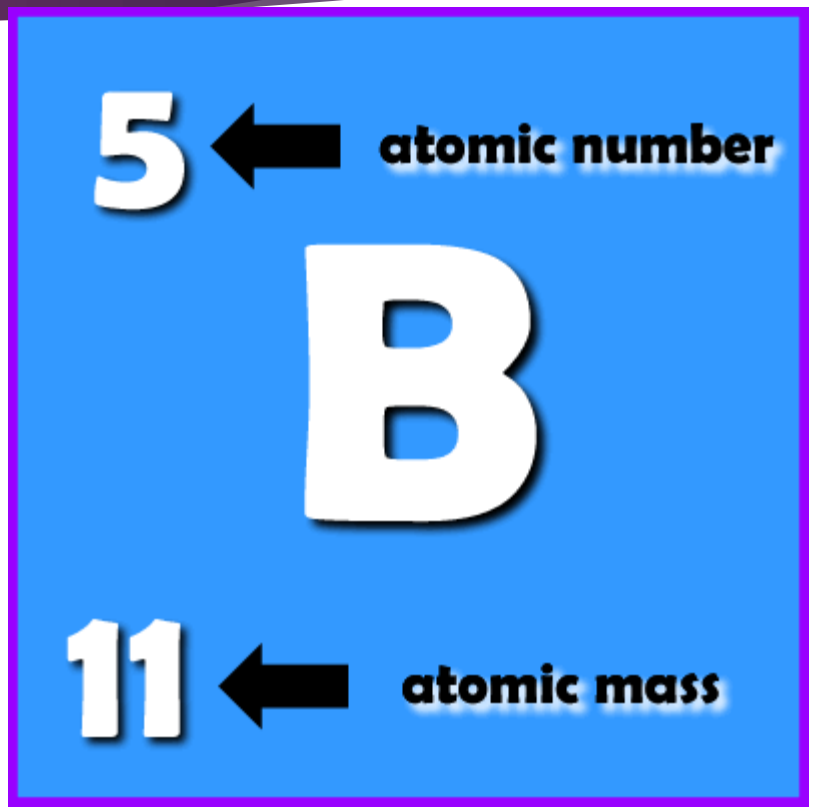
Figuring out the Number of Parts in an Atom



- To figure out the number of protons of an atom, look at the atomic number on the periodic table (number of protons for Gold is **79**.)
- To figure out the number of electrons of an atom, look at the atomic number on the periodic table (it will be the same number as the protons, for Gold it will be **79**.)
- To figure out the number of neutrons of an atom, you must look at the atomic weight of the atom on the periodic table, and then subtract the atomic number.
- For Gold, you will subtract 197-79=**118**. So the number of neutrons for Gold is **118.**

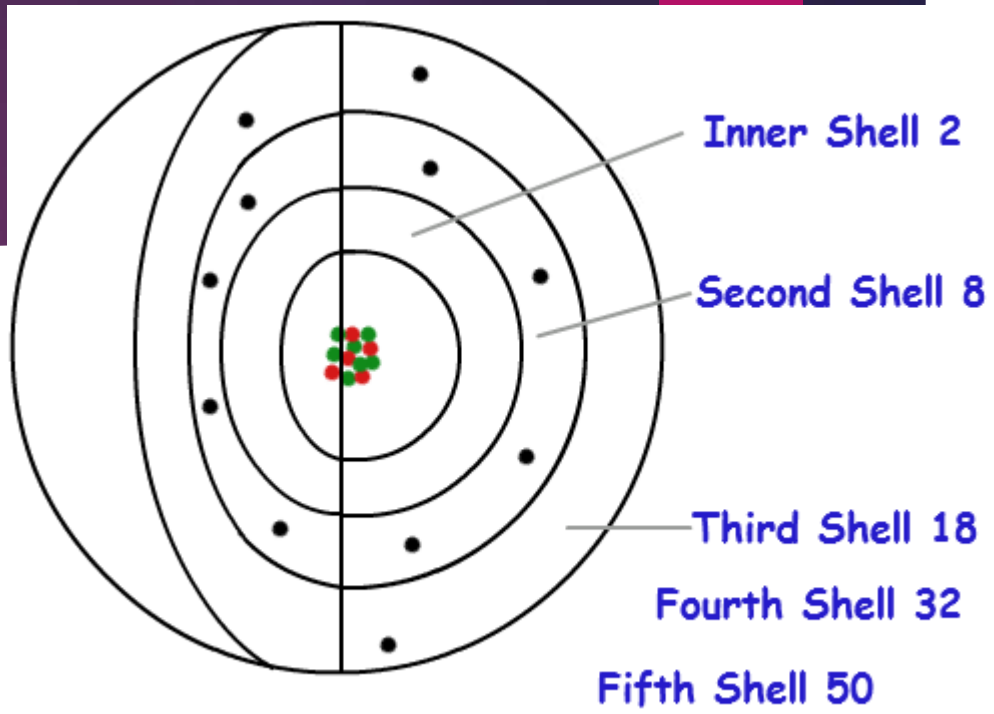
Drawing an Atom

- Look at the element block for Boron on the Periodic Table.
- Figure out the numbers for the protons, electrons, and neutrons for a Boron atom.
- Protons = **5**
- Electrons = **5**
- Neutrons = **6 (11-5)**



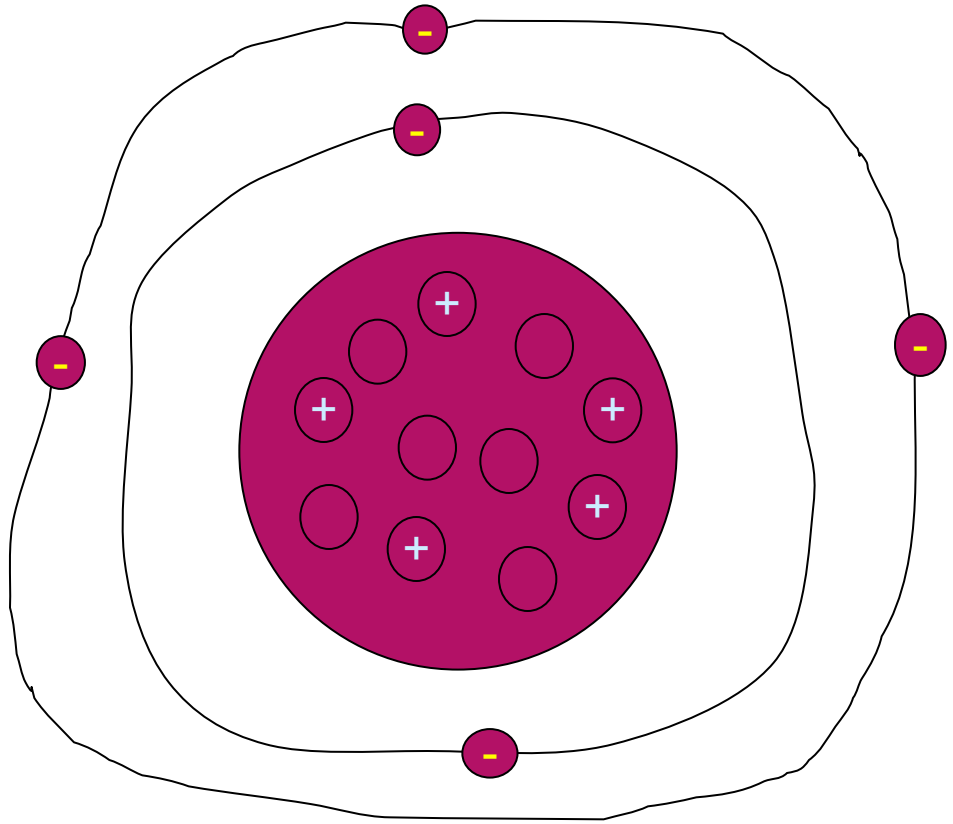
Drawing an Atom

- Now that we have figured out the numbers of the particles in an atom, we can start to draw.
- Always start with drawing the nucleus first.
- Add the protons and neutrons inside the nucleus.
- Add the electrons on the out side of the nucleus. The electrons are placed in the electron cloud and we use rings or circles to represent the electron cloud. Each ring has a specific amount of electrons a ring can hold. (See picture)



Drawing an Atom

- Our atom of Boron should look something like this:
- Protons: ***5***
- Electrons: ***5***
- Neutrons: ***6***

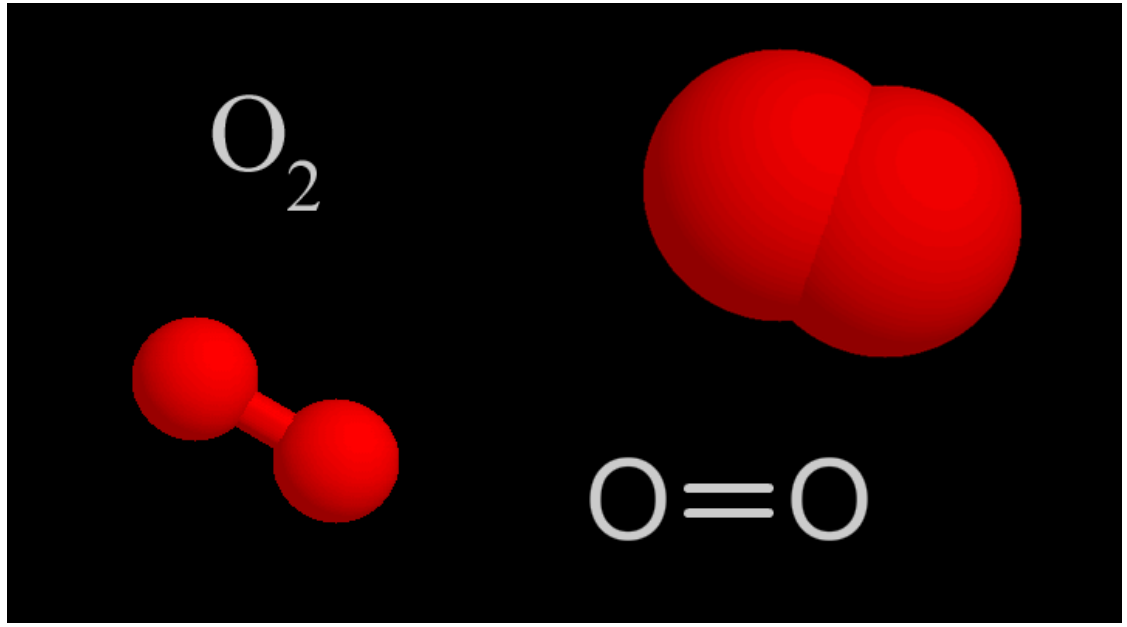


Molecules

- Two or more **atoms** that are held together form a molecule.
- Atoms of the same **element** can form a molecule or atoms from different elements can form a molecule
- For example: 2 atoms of Oxygen can form an Oxygen molecule, **O_2**.
- The 2 behind the O is called a **subscript**. It shows us how many atoms of each element are in the molecule.

Molecules

- Models of an Oxygen molecule:

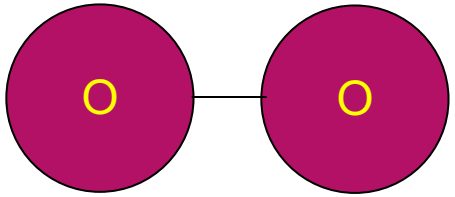


Compounds

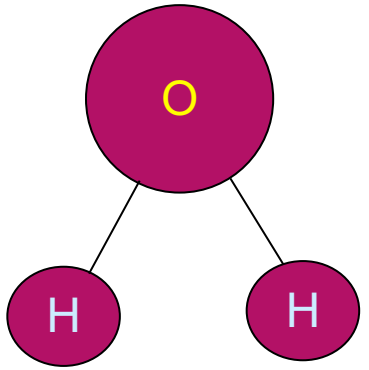
- Atoms of 2 or more elements join together to form a **compound**.
- An Oxygen atom and 2 Hydrogen atoms can form a **water** molecule, H_2O.
- H_2O is the **formula** for water. It shows us that there are 2 atoms of hydrogen and 1 atom of oxygen.
- If there is only 1 atom of an element in a compound, we do NOT write a 1 for a subscript. We only write the symbol of the element.

Molecules & Compounds

- Now draw a molecule of Oxygen and a compound of water:



Oxygen Molecule



Water Molecule

Mixture

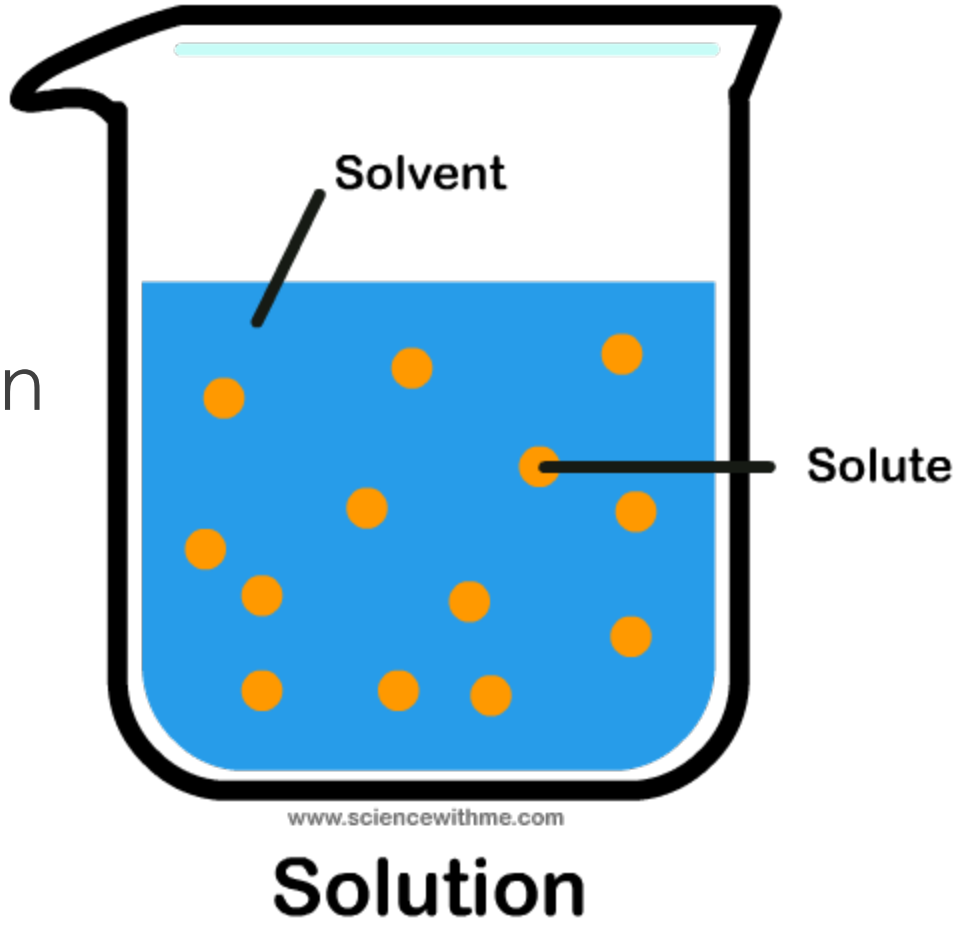
- A mixture is a combination of 2 or more substances that do not lose their identifying characteristics when combined
- They are **mixed**, not joined chemically.
- They can also be easily **separated.**
- Examples: **salad**, milk and cereal, trail mix

Solution

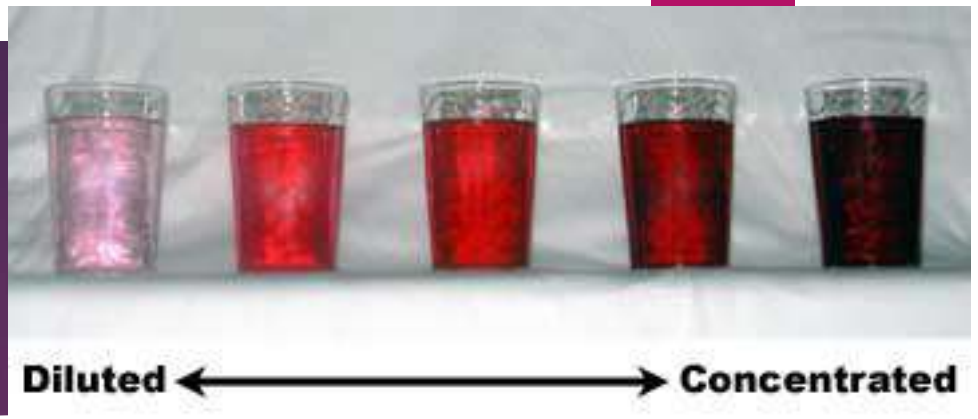
- A solution is a mixture of molecules made by dissolving one substance into another substance.
- All solutions are mixtures but not all mixtures are **solutions.**
- It is possible to **separate** the 2 substances, but not very easily.
- Examples: sugar dissolved in tea or Kool-Aid
- The **sugar** is still there even though it is dissolved and you don't see it.
- In order to separate the solution, you would have to **evaporate** the liquid

Solution

- There are 2 parts to a solution: solutes & solvents.
- A **solute** is a substance that dissolves in another substance. Ex. Sugar dissolving in water. The sugar is the solute
- A **solvent** is a substance that dissolves a solute. Ex. Sugar dissolving in water. The water is the solvent.



Solution



- There are 2 kinds of solutions: diluted and concentrated.
- A **diluted** solution is a weak solution that contains a small amount of solute and a large amount of solvent. Ex. Putting a tablespoon of sugar in a gallon of sweet tea.
- A **concentrated** solution is a strong solution that contains a small amount of a solvent and a large amount of a solute. Ex. Putting 4 cups of sugar in a gallon of sweet tea.

Suspension

- A suspension is a mixture in which particles of a substance are scattered in another substance but NOT dissolved.
- Examples: oil & vinegar salad dressing, orange juice, peanut butter, & **milk.**